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ABSTRACT

This curriculum guide, developed to establish statewide curriculum standards for the Louisiana Competency-based Education Program, contains the minimum competencies and process skills that should be included in a life science course. It consists of: (1) a rationale for an effective science program; (2) a list and description of four major goals of science; (3) a list and description of eight basic process skills (such as predicting and classifying) and five integrated processes (such as controlling variables and defining operationally); and (4) a 10-part curriculum outline. These parts provide performance objectives correlated with a concept, process skill(s), and suggested activities for each of the following major topic areas: scientific method; organization of life (differences between living and non-living things, the cell, unity of functions, and classification); protists; simple plants; plants; lower animals; human biology (body systems); reproduction; heredity and genetics; and ecology. A list of audiovisual suppliers and brief comments on evaluation techniques are also provided. (JN)

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STATE OF LOUISIANA
DEPARTMENT OF EDUCATION

LIFE SCIENCE CURRICULUM GUIDE

BULLETIN 1614
1984

Thomas G. Clausen, Ph.D.
Superintendent

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STATE OF LOUISIANA

DEPARTMENT OF EDUCATION

LIFE SCIENCE CURRICULUM GUIDE

BULLETIN 1614

1984

Issued by

Office of Academic Programs

THOMAS G. CLAUSEN, Ph.D.

Superintendent

FOREWORD

Act 750 of the 1979 Louisiana Legislature (R.S. 17:24.4) established the Louisiana Competency-Based Education Program. One of the most important provisions of Act 750 is the mandated development and establishment of statewide curriculum standards for required subjects. These curriculum standards include curriculum guides which contain minimum skills, suggested activities, and suggested materials of instruction.

During the 1979-80 school year, curriculum guides were developed by advisory and writing committees representing all levels of professional education and all geographic areas across the State of Louisiana for the following Science courses: Elementary K-6, Life Science, Earth Science, Physical Science, General Science, Biology, Chemistry, and Physics.

During the 1982-83 school year, the curriculum guides were piloted by teachers in school systems representing the different geographic areas of the State as well as urban, suburban, inner-city, and rural schools. The standard populations involved in the piloting reflect also the ethnic composition of Louisiana's student population. Based upon participants' recommendations at the close of the 1982-83 pilot study, the curriculum guides were revised to ensure that they are usable, appropriate, accurate, comprehensive, relevant, and clear.

Following the mandate of Act 750, the revised curriculum guides will be implemented statewide in the 1984-85 school year. The statewide implementation is not, however, the end of the curricular development process. A continuing procedure for revising and improving curricular materials has been instituted to ensure that Louisiana students have an exemplary curriculum available to them--a curriculum that is current, relevant, and comprehensive. Such a curriculum is essential if we are to provide the best possible educational opportunities for each student in the public schools of Louisiana.

Thomas G. Clausen

Thomas G. Clausen, Ph.D.

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William E. Stephens, Jr.
Assistant Superintendent
Office of Academic Programs

Helen Brown, Ed.D., Director
Bureau of Curriculum, Inservice,
and Staff Development

P. Edward Cancienne, Jr., Ph.D.
Director
Bureau of Secondary Education

CURRICULUM WRITING TEAM

Carol Haynes (CHAIRMAN)
Jack Hays Junior High School
Old Sterlington Road
Monroe, Louisiana 71203

Dr. Patsy Boudreaux (CONSULTANT)
Ruston High School
Cooktown Road
Ruston, Louisiana 71270

Marjorie King (CONSULTANT)
Jefferson Parish School System
519 Huey P. Long Avenue
Gretna, Louisiana 70053

Michael Chapman
Rosteet Junior High School
2423 Sixth Street
Lake Charles, Louisiana 70601

Aleta Johnson
Carter G. Woodson Junior High School
2514 Third Street
New Orleans, Louisiana 70113

Sam Perkins
East Natchitoches Junior High School
1001 East 5th Street
Natchitoches, Louisiana 71457

Ernestine Sudds
Linwood Junior High School
401 West 70th Street
Shreveport, Louisiana 71106

CURRICULUM REVIEW TEAM

Dr. Milton Fingerman (CONSULTANT)
Chairman, Biology Department
Tulane University
6823 St. Charles Avenue
New Orleans, Louisiana 70118

Joy Tingle (CONSULTANT)
Terrebonne Parish School Board
Post Office Box 5097
Houma, Louisiana 70361

Catherine Smith
Webster Junior High School
Post Office Box 857
Minden, Louisiana 71055

Leslie Weber
Adams Junior High School
5535 Henican Place
Metairie, Louisiana 70002

PREFACE

The Life Science Curriculum Cuide contains the minimum competencies and process skills that should be included in a Life Science course. Each teacher should build on the foundation of these minimum competencies to establish the maximum program possible for his/her students. The teacher must take special care to incorporate all skills contained in this guide within the framework of his/her instructional program. The guide is flexible enough to be adapted to most of the commercial basal programs; and teachers may adjust the sequence of content based on the needs of their students, the available equipment, and the textbooks.

The guide contains suggested activities designed to assist the teacher in teaching each competency; however, the teacher and the students should not be limited to these activities nor bound to use all of them. There are many other activities available to the teacher which will help him/her to present each competency and process skill to the student. It is hoped that the teacher will be resourceful in using many types of experiences to teach the topics listed.

Methods of science instruction, to be most effective, must be based upon the development of process skills in critical thinking. An effort has been made to incorporate numerous process skills in the suggested activities, and the teacher should use as many of these skills as possible in daily instruction.

This curriculum guide should be of special benefit to the teacher in helping to organize the Life Science course. It is suggested that additional textbooks, workbooks, and laboratory manuals be consulted for activities, demonstrations, and experiments to supplement those described in this curriculum guide.

RATIONALE

Developments in science technology have improved our way of living and have become a major influence on our culture. No one in our culture escapes the direct influence of science. Because of the impact of science on our social, economic, and political institutions, the education of every responsible citizen must include not only the basic principles of science but also the attitudes and processes of scientific thought.

The nature of science itself determines the way that it should be taught. The definition of science is a two-fold one: It is (1) an unending method or process of seeking new knowledge, and (2) the body of knowledge which results from this search. Science is an intellectual, active process which involves an investigator of any age and something to investigate. The discipline of science taught by the process approach teaches the student how to learn, and that intellectual gain is a permanent one for the student.

The process approach develops the intellectual abilities of students. Some students develop thinking skills in the normal course of growing up in a complex world, but the acquisition of useful skills and attitudes is by no means automatic. Many students succeed in school by repeating what they are told in a slightly different form or by memorizing; such strategies are of little extended value. At present, relatively few students develop persistence in and zest for dealing with new concepts because they are not aware of their intellectual capabilities. Thus, they need literally to experience application of scientific process skills in different situations.

To be most effective, methods of science instruction must be based upon the development of skills in critical thinking. Guided practice in experimenting, observing, gathering information, organizing facts, and drawing conclusions will help to develop critical thinking skills. Laboratory techniques should be employed whenever possible, and inquiry teaching/learning situations using both deductive and inductive reasoning should be the predominant method used in all classroom activities. The teacher's role in a process-oriented science classroom includes being a provider of problems, a discussion leader, a supplier of clues (when necessary), and a skillful questioner, i.e., a facilitator of learning activities. Thus, the aim of an effective science program should be to equip each child with competencies in the basic processes and concepts of science through individual participation in activities and investigations specifically designed to develop such capabilities.

GOALS

Achieving scientific literacy involves the development of attitudes, process skills, concepts, and social aspects of science and technology. Based upon this belief, the following major goals of science are stated:

1. To Foster Positive Attitudes Toward the Scientific Process

   Students will develop a deep appreciation of the role the scientific process plays in their everyday lives.

2. To Develop Process Skills

   Process skills development should be an integral part of science activities for students. Students should be given opportunities to develop those intellectual processes of inquiry and thought by which scientific phenomena are explained, measured, predicted, organized, and communicated.

   Basic Process Skills: Observing, inferring, classifying, using numbers, measuring, using space-time relationships, communicating, predicting.

   Integrated Process Skills: Controlling variables, defining operationally, formulating hypotheses, interpreting data, experimenting.

3. To Acquire Knowledge

   Included in the basic science curriculum should be those scientific facts, principles, concepts, and terms which will enable the students to understand and interpret natural phenomena.

   Areas of Knowledge: Life Science, Physical Science, Earth Science

4. To Recognize Social Aspects of Science and Technology

   The students should (a) understand the interrelationships of science, technology, and social and economic development; and (b) recognize both the limitations and the usefulness of science and technology in advancing human welfare.

PROCESS SKILLS

Eight basic process skills are stressed: (1) observing, (2) inferring, (3) classifying, (4) using numbers, (5) measuring, (6) using spacetime relationships, (7) communicating, and (8) predicting. There is a progressive intellectual development with each process category. A brief description of each basic process skill follows:

OBSERVING: To observe is to use one or more of the five senses to perceive properties of objects or events as they are. Statements about observations should be (1) quantitative where possible, (2) descriptive regarding change(s) and rates of change(s), and (3) free of interpretations, assumptions, or inferences.

INFERRING: To infer is to make statements about objects or events based on observations but not the result of direct perception. Inferences may or may not be accurate interpretations or explanations of observations. Inferences are based on (1) observations, (2) reasoning, and (3) past experience of the observer. Inferences require evaluations and judgment. Inferences based on one set of observations may suggest further observation which in turn requires modification of original inferences. Inferences lead to predictions.

CLASSIFYING: Classifying is the grouping or ordering of phenomena according to an established scheme. Objects and events may be classified on the basis of observations. Classification schemes are based on observable similarities and differences in arbitrarily selected properties. Classification keys are used to place items within a scheme as well as to retrieve information from a scheme.

USING NUMBERS: To use numbers is to deal with the measurement, properties, and relationships of quantities by the use of symbols.

MEASURING: To measure is to find out the extent, size, quantity, capacity, etc., of something, especially by comparison with a standard. Once the concept of measuring is introduced and mastered in the kindergarten and first grade, the metric and/or SI system should be used exclusively.

USING SPACE/TIME RELATIONSHIP: Space/Time relationships is the process that develops skills in the description of spatial relationships and their changes with time. It includes the study of shapes, time, direction, spatial arrangement, symmetry, motion, and rate of change.

COMMUNICATING: To communicate is to pass information along from one person to another. Communications may be verbal, nonverbal (i.e., gestures), written, or pictorial (pictures, maps, charts, and graphs). Communications should be concise, accurate, clear, precise descriptions of what is perceived.

PROCESS SKILLS

As the progressive, intellectual development proceeds in each basic process skill, the interrelated nature of the processes is manifested in the five integrated processes: (1) controlling variable, (2) defining operationally, (3) formulating hypotheses, (4) interpreting data, and (5) experimenting. A brief description of each integrated process skill follows:

PREDICTING: Predicting is the formation of an expected result based on observations and past experience. The reliability of predictions depends upon the accuracy of past and present observations and upon the nature of the event being predicted. Progressive series of observations and graphs to ascertain patterns of events are important tools of prediction in science.

CONTROLLING VARIABLES: A variable is any factor in a situation that may change or vary. Investigators in science and other disciplines try to determine what variables or factors influence the behavior of a system and how they influence it. In order to do this they manipulate one variable, called the manipulated (independent) and measure the effect on another variable, called the responding (dependent) variable. As this is done all other variables are held constant. If there is a change in only one variable and an effect is produced on another variable, then the investigator can conclude that the effect has been brought about by the changes in the manipulated variable. If more than one variable changes, there can be no certainty at all about which of the changing variables causes the effect on the responding variable.

DEFINING OPERATIONALLY: To define operationally is to tell the minimal things to do or to look for to identify the object or event being defined. It spells out the minimum things to do for a specific situation; it gives the minimum amount of information needed to differentiate that which is being defined from other similar phenomena.

FORMULATING HYPOTHESES: Questions result from observations made and usually precede an attempt to evaluate a situation or event. Questions, when properly stated, are problems to be solved through application of the other processes of science. The attempt to answer one question may generate other questions. The formulation of hypotheses depends directly upon questions, inferences, and predictions. Hypotheses are generalized statements about a set of observations or inferences. The process of formulating hypotheses consists of devising a statement which can be tested. Hypotheses, like inferences, can be tested so that they are verified or proven false. When more than one hypothesis is suggested by a set of observations or inferences, each must be stated and tested separately. A workable hypothesis is stated in such a way that, upon testing, its creditability is established. The more tests made that provide data that support a hypothesis, the more confident we are of the correctness of the hypothesis.

INTERPRETING DATA: The process of interpreting data may include many behaviors such as (1) recording data in a table, (2) constructing bar and line graphs, (3) making and interpreting frequency distributions, (4) determining the median, mode, mean, and range of a set of data, (5) using slope or analytical equations to interpret graphs, and (6) constructing number sentences describing relationships between two variables. Interpreting data requires going beyond the use of skills of tabulating, charting, and graphing to ask questions about the data which lead to the construction of inferences and hypotheses and the collecting of new data to test these inferences and hypotheses. Interpretations are always subject to revision in the light of new or more refined data.

EXPERIMENTING: (Using the scientific method): Experimenting is the process of designing a procedure that incorporates both the basic and integrated process skills. An experiment may begin as a question for the purpose of testing a hypothesis. The basic components of experimenting are as follows:

1. Constructing a hypothesis based on a set of data collected by the person from observations and/or inferences.

2. Performing a test of the hypothesis. The variables must be identified and controlled as much as possible. Data must be collected and recorded.

3. Describing or interpreting how the data support or do not support the hypothesis, i.e., deciding whether the hypothesis is to be accepted, modified, or rejected.

4. Constructing a revised hypothesis if the data do not support the original hypothesis.

CONTENT OUTLINE

I. Scientific Method
   A. Steps in scientific method
   B. Use of scientific equipment
   C. Laboratory safety
   D. Measurement and metric system

II. Organization of Life
   A. Differences between living and nonliving things
      1. Characteristics
      2. Stimulus response behavior
   B. The Cell
      1. Cell structure
      2. Cell division
      3. Diffusion and osmosis
      4. Tissues and organs
   C. Unity of functions
      1. Growth
      2. Need for food
      3. Response to stimuli
      4. Need to eliminate waste
      5. Need to reproduce
   D. Classification of living things
      1. Method of classifying
      2. The Three Kingdoms

III. Protists
   A. Structure
   B. Life activities

IV. Simple Plants
   A. Structure
   B. Life activities

V. Plants
   A. Nonvascular plant
      1. Structure
      2. Life activities
   B. Vascular plant
      1. Structure
      2. Life activities

VI. Animals (lower)
   A. Invertebrate
      1. Structure
      2. Life activities
   B. Vertebrate
      1. Structure
      2. Life activities

VII. Human Biology - Body Systems
   A. Digestive system
      1. Proper diet
      2. Deficiency diseases
   B. Circulatory system
   C. Respiratory system
   D. Nervous system
   E. Endocrine system
   F. Excretory system
   G. Skeletal system
   H. Muscular system

VIII. Reproduction
   A. Asexual reproduction
   B. Sexual reproduction

XI. Heredity and Genetics
   A. Principles and laws
   B. Application of laws to plants and animals
   C. Adaptation of organism to environment

IX. Ecology
   A. Interrelation between plants and animals and their environment
   B. Conservation

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
I. SCIENTIFIC METHOD The student will be able to: 1. List and define steps in scientific method: a. Problem b. Collecting information c. Forming hypothesis d. Testing hypothesis through experimentation (1) Control variables (a) Independent (b) Dependent (c) All other variables (2) Collect data (a) Charts (b) Graphs (c) Notes e. Results and conclusions (discuss patterns observed in data)	Scientific method	Observing, communicating, inferring, formulating hypotheses, collecting data, controlling variables, interpreting data	Bird seed experiment: Students will place the same number and type of seeds on a cookie sheet which has been divided into five compartments of equal size with adhesive tape. (Seeds in each compartment are dyed four different colors, and the natural colored seed is put into one compartment.) Formulate hypothesis (what the students think will happen to the seeds). Put cookie sheet outside where birds will see it. Observe every day. Make a chart and collect data. Chart Sample: Days of experiment Seed Color Natural Red Green Yellow Purple 1 2 3 4 5 6 7 8 9 10 On the above chart enter the number of seeds that remain on the cookie sheet each day. Tell which groups of seeds are the experimental and

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			which is the control group. Graph results in a line graph. Show the way a line graph is constructed and how the independent or manipulated variable (color) and the dependent or responding variable (number of seeds left after 10 days) are placed on horizontal and vertical axes, respectively. <u>Line Graph Sample</u>:
			Draw conclusions.
2. Sequence the principal steps in a science project (problem, hypothesis, experimentation, conclusion).	Scientific method	Inferring, classifying	When presented with the pertinent parts of a science project, the student will organize the project in sequence. Suggestion: Give each student a packet of 5 to 10 seeds. Have the student design an experiment using

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			the seeds. Student should turn in a written lab report identifying variables, hypothesis, control groups, experimental groups, and conclusions.
3. Perform a science project with control variables. Identify: hypothesis, independent and dependent variables, and conclusions.	Control variables	Observing, inferring, experimenting, controlling variables, interpreting data	Teacher-student discussion. Oral response to questions. Lab: Beef broth in two test tubes--sealed and unsealed--for one week. Observe, smell, test with litmus paper, and observe drops from each under microscope and/or observe test tubes in beam from flashlight. Have students state the hypothesis, independent and dependent variables, and conclusions. Manipulated variable: sealed tube not exposed to air.
4. Identify the principal parts of a microscope.	Use of microscope	Observing	Use hand lens to observe finger prints. Label parts of microscope on ditto.
5. Demonstrate use of a microscope in viewing a slide.	Use of microscope	Communicating	Student demonstration of skill in using microscope. Practice focusing by observing hair and thread. Cut out letters (f) and (e) from newspaper and observe.
6. Demonstrate general safety procedures for laboratory work.	Laboratory safety	Experimenting, communicating, manipulating	Student discussion on safety rules by State Department of Education. Students draw a lab safety poster to display in room. (See appendix #1.)

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
7. Use and compare the units of the metric system.	Metric system	Observing, using numbers, measuring	Students will use the metric system to measure length, mass, and volume. 1. Use laboratory balances to measure mass. 2. Use graduate cylinders to measure volume. 3. Race meal worm through a test-tube to measure how far it travels in mm and cm. to measure length.
8. Point out on a chart the difference between Fahrenheit and Celsius scales, emphasizing the freezing point, boiling point, and body temperature.	Metric system	Classifying, using numbers, interpreting data	Construction of temperature scale
9. Measure and graph heat loss (in Celsius) in insulated and uninsulated containers.	Metric system	Using numbers, measuring, interpreting data, experimenting	Student Lab: Put two beakers (same size) in two coffee cans. Surround one beaker with sand. Boil water, pour it in both beakers (use funnel). At intervals, measure temperatures of both beakers. Record on line graph. Example: T e 100° m 90° p 80° e 70° r 60° a 50° t 40° u 10 20 30 40 50 60 r TIME (in minutes) e _____Insulated ----------Uninsulated

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
II. ORGANIZATION OF LIFE			
10. Distinguish between living and nonliving things.	Living and nonliving things	Observing, classifying	From a display of things, the student divides living and nonliving things into their proper groups and describes the basis on which the classification was made. Optional: Compare a mercury ameba to a live goldfish on the overhead. Mercury ameba can be made by pouring 10 to 15 ml of diluted HCl into a dish and adding one large drop of mercury. Add 1 to 3 crystals of potassium dicromate to mixture and the crystals will appear to be eaten by the mercury.
11. Define the terms behavior, stimulus, and response.	Response to stimulus	Observing, defining operationally	Teacher-student discussion. Provide 10 sentences describing responses to stimuli from which the student will select the stimulus and response. Example: The boy touched the hot stove and jumped. Stimulus--touching hot stove; response--jumping. Allow students to make up their own sentences with a stimulus and a response.
12. Relate different stimuli to various responses.	Response to stimulus	Observing, inferring, experimenting	Lab on response of animals and plants to various stimuli (mealworm responses to various stimuli, e.g., touch, light, heat, and water).
13. State that food is needed for: a. Energy b. Growth in organisms	Need for food	Observing, inferring, communicating	Teacher-student discussion

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
14. Give examples of waste elimination in an organism.	Elimination of waste	Observing, communicating	Lab activities to show waste elimination. Example: Yeast and sugar placed in water in a test tube and pebbles placed in water in another test tube. Air bubbles in yeast indicate elimination of gas while pebbles give no reaction.
15. State the need for reproduction by living things.	Reproduction	Observing, inferring, communicating	Teacher-student discussion
16. Define cell.	Cell	Observing	Teacher-student discussion
17. Locate and identify the parts of a cell.	Cell structure	Observing, communicating	Student lab on cells. Observe under a microscope onion, cork, or cheek cells. Draw and label parts. Order packet from American Cancer Society on "Cellular Structure."
18. Differentiate between plant and animal cells.	Cell structure	Inferring, observing, experimenting	Lab on plant and animal cells. Lettuce, eludea, and cheek - cells can be used. Draw and label showing differences and similarities in cell structure.
19. State the cell theory.	Cell theory	Observing, defining operationally	Teacher-student discussion
20. Identify the process of mitosis.	Cell division	Observing, defining operationally	Use audiovisual aids.
21. Demonstrate principles of osmosis and diffusion.	Osmosis and diffusion	Observing, defining operationally, communicating, experimenting, formulating hypothesis	Labs on diffusion and osmosis: 1. Diffusion--drop of ink, food coloring or potassium permanganate into water. 2. Osmosis--slice 3 pieces

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			from a potato. Place each in a beaker. In beaker add: #1 - 100 ml of distilled H_2O. #2 - 1 gm. of salt dissolved in 99 ml of H_2O. #3 - 5 gms. of salt dissolved in 95 ml of H_2O. Observe and feel potato slices after 1 day. Results will demonstrate osmosis.
22. Distinguish among cell, tissue, and organ.	Cell, tissue organ	Observing, defining operationally, inferring	Observe slides and use pictures to illustrate types of tissues.
23. Group a set of objects, distinguish the similarities and differences in objects, and state the criteria used for groupings.	Classification	Observing, inferring, classifying	Lab activity on dividing dissimilar objects into groups. (Example: container lab) Students mark containers with numbers and are responsible for creating a classification system with containers. Classify: glass vs non-glass/color vs noncolor. Have students bring 5 containers to school. Group students into groups of 4 or more.
24. List and identify the three kingdoms or organisms (protists, animals, plants).	Three kingdoms	Observing, communicating, classifying	Teacher-student discussion (Let students bring pictures of living things. Divide pictures into three kingdoms.)
25. Classify members of the three kingdoms in a given list.	Three kingdoms	Inferring, classifying	Individual work on teacher handout of mixed list of three kingdoms

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
III. PROTISTS			
26. Identify processes of life in an amoeba, a typical protist. Life processes limited to: a. Movement b. Nutrition c. Reproduction d. Excretion e. Irritability	Protist, amoeba	Observing, communicating, defining operationally	Student lab on amoeba (hay infusion) handout sheet on body structure will clarify processes. (Use audiovisual aids, filmstrips.) A micro-projector (bioscope) may be used to observe specimen with a larger group.
27. Compare and contrast the above life processes in the amoeba, paramecium, and euglena.	Protist, amoeba, euglena, paramecium	Observing, inferring, communicating, classifying	Student lab on paramecium and euglena and algae (may be prepared slides). Handout sheets on body structure. (Use audiovisual aids, filmstrip.) Observe the 3 types of bacteria (bacillus, coccus, and spirillum) under the microscope. Methyl cellulose or sewing thread may be used to trap or slow down movement.
IV. SIMPLE PLANTS			
28. Identify processes of life in mold and yeast, simple plant-like organisms.	Fungi, fern	Classifying, observing, experimenting	1. Bread mold experiment: Rub bread across a dusty surface. Place in jar with a small piece of moistened paper. Add lid and store in dark place for about 3 days. Examine with hand lens observing cell walls and spore cases. 2. Observe yeast cells under microscope. (Prepare yeast as directed on package.) 3. Observe the underside of fern leaves for spores.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
V. PLANTS			
29. Identify the structure and function of the parts of bean and corn seeds: cotyledons, embryo, leaf, root, endosperm, seed coat.	Seeds	Observing, inferring	Cut bean and corn seeds in half. Identify structure. Test seed for presence of stored starch using drop of iodine. Soak seeds overnight before cutting.
30. Describe the conditions necessary for seed germination.	Germination	Experimenting, controlling variables, collecting data	Germinate pea, bean, radish, tomato, or grass seeds in six petri dishes divided into four sections with wooden strips. pea grass radish tomato Bottom of dishes should be covered with wet paper towels. After adding an equal amount of seeds to each section of the six dishes: Stand wooden splints upright in petri dish to divide the seeds. Jar caps may be used if no petri dishes are available. a. Cover one with aluminum foil and place one in light. b. Place one in refrigerator and one at room temperature. c. Do not water one at all during investigation, but water the other. Note: Place a few drops of water daily in all being tested except the one dry one.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			Observe containers daily; record rates of germination on data chart. Identify all the variables (light, temperature, water), and determine the percentage of germination under the different conditions.
31. Name the necessities for plant growth (water, light, CO_2, minerals, O_2).	Plants	Using numbers, measuring, observing, inferring, controlling variables, experimenting, formulating hypotheses, interpreting data	Student experiments (two week project) on controlling variables on necessities for plant growth.
32. Compare the structure of various kinds of plants. Name the part and match the part to its function when given a diagram of a typical plant.	Roots, stems, and leaves	Observing, classifying, defining operationally	Identify the various parts of different plants on display. Lab on seed and plant dissection. Observation of plant growth also recommended. Seed (bean, acorn, corn). Dissection--any plant that flowers.
33. Compare and contrast vascular and nonvascular plants as to transportation of fluids.	Vascular and nonvascular	Observing, inferring	Lab on typical vascular and nonvascular system emphasizing method of transport using food coloring or syrup. (Celery, carrot or turnip)
34. Divide a given list of plants into vascular and nonvascular: fern, mosses, liverworts, flowering plants, trees.	Vascular and nonvascular	Observing, inferring, classifying	Comparative study of the structures of plants. Divide plant pictures into vascular and nonvascular.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
35. Identify the structure and function of flowers.	Flower	Observing, communicating	Identify the various parts of different flowers on display: sepal, petal, receptacle, ovary, pistil, anther, stamen, and style. Dissect a flower. (Lillies and gladioli are complete flowers and easy to use.)
36. Compare and contrast angiosperms and gymnosperms as to seed cover.	Angiosperm, gymnosperm	Observing, inferring	Examination of samples of both types of seeds. Handout sheet and audio-visual aids
37. Divide a given list into angiosperms and gymnosperms (pine, spruce, fir, grass, tomato, maple tree, rose).	Angiosperm, gymnosperm	Classifying, predicting	Provide handout which contain a list of both groups of plants and ask students to group each based on commonalities.
38. Describe the function of photosynthesis (capturing of light energy and storing it as plant food). Light energy + CO_2 + H_2O Food (plant energy) + O_2	Photosynthesis	Defining operationally	Place a healthy leaf that has been exposed to light in a beaker with one inch of water and boil until leaf is soft. Remove leaf and place in test tube 1/3 full of alcohol. (CAUTION: DO NOT PLACE NEAR OPEN FLAME.) Warm test tube in beaker of hot water until leaf turns white. Remove leaf and add a small amount of iodine. After a few minutes, rinse off leaf and examine for presence of starch (indicated by black color).
39. Identify chloroplast in a green leaf.	Photosynthesis	Observing, experimenting	1) Observe Elodea leaf under microscope 2) Crush a leaf, boil in water for about 5 minutes. Fill a test tube 1/2 full with alcohol. Put in boiled leaf and heat in alcohol for 5 minutes. Observe results.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			CAUTION: Alcohol is combustible. Chlorophyll will be removed from the leaf when heated in alcohol.
40. Identify the respiration process in a leaf.	Respiration	Observing, experimenting	Use a microscope to observe guard cells and stomata in epidermis of lettuce leaf.
VI. ANIMALS			
41. Classify a given list of animals into vertebrates and invertebrates: worm, sponge, amoeba, starfish, clam, frog, dog, man, grasshopper.	Animals	Observing inferring, classifying	Divide pictures of animals brought by students into two major groups. Hand out lists. Construct a chart--herbivores, carnivores and omnivores.
42. Compare the systems and differentiate the internal and external structures of the invertebrates.	Invertebrate systems	Identifying, classifying, Inferring	Obtain specimens. If not available, use picture illustrations to compare and examine animals, sponge, hydra, planaria, tapeworm, flatworm, starfish, crawfish, grasshopper, oyster, or snail. If possible, dissections should be performed on several of the animals listed. Optional - Teacher may wish to review metamorphosis with invertebrate animals rather than frogs.
43. Diagram the digestive tract of the earthworm labeling the mouth, esophagus, crop, gizzard, intestine, and anus.	Earthworm	Observing, communicating	Lab on dissection of earthworm (optional). Draw and label the digestive system of an earthworm.
44. Define the digestive function of the mouth, crop, and gizzard, intestine, and anus.	Earthworm	Observing, communicating, inferring, predicting	After the dissecting lab, the students will associate the major parts with their basic functions and write

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			them down: 1. Mouth--gathers food 2. Crop--stores food 3. Gizzard--brakes up food 4. Intestine--absorbs food 5. Anus--eliminates food
45. Compare the systems and differentiate the internal and external structures of fish, amphibians, reptiles, birds, and mammals.	Vertebrate Systems	Identifying, classifying, inferring	Identify the five classes of vertebrates and discuss in class. Characteristics and special adaptations of Birds Reptiles Amphibians Fish Mammals
46. Identify the parts and specify the functions of the digestive tract of the frog.	Frog	Observing, inferring, predicting	Participate in lab activities on the digestion of a frog. Hand out diagrams. Dissect a frog. Metamorphosis should be reviewed with students.
47. Identify the parts and specify circulatory system of a frog or fish.	Frog's circulatory system	Observing, inferring, predicting	1. Wrap a goldfish in wet cotton and observe the tail fins under a microscope to see blood cell movement. 2. Observe blood cells between toe web. (May use micro-projector or bioscope with larger groups)
VII. HUMAN BIOLOGY			
48. Define digestion and list the organs of the digestive system.	Digestive system	Observing, communicating, defining operationally	Audiovisual aids on digestion

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
49. Differentiate between mechanical and chemical digestion.	Digestive system	Observing, inferring, communicating, experimenting	Chemical test for presence of starch or simple sugars, or fats, oils and protein. Teacher-student discussion on mechanical digestion. Cracker test with pure saliva and with saliva and chewing. Test both with Benedict's solution for presence of sugars.
50. Identify in sequence the digestive organs and their functions.	Digestive system	Observing, communicating, inferring, classifying	Audiovisual aids and student diagrams. Students will trace the digestion of food, using words, not pictures.
51. Evaluate personal diet and plan a three-day diet that includes the basic four food groups (milk, meat, vegetables-fruits, bread-cereal).	Digestion, nutrition	Classifying, communicating, interpreting data	On a chart, student keeps track of diet for three days. Student evaluates his own diet in terms of basic four food groups. Student plans a menu for three days that includes all of the basic four in a well-balanced diet.
52. Make a class chart of the calorie intake (for one day) for each student. Figure out class average and average by sex.	Digestion, nutrition	Using numbers, measuring, interpreting data	Choose one day from the above (#51) exercise. Figure out total calories consumed using a calorie table. Put all information on chalkboard for students to construct a calorie intake (line) graph, ranging from highest student intake to lowest student intake. Find class average, boys' average, and girls' average. Indicate averages on a bar graph.
53. Locate and list foods with Vitamin C which prevent scurvy.	Digestion, nutrition, and disease	Classifying, measuring	Have students bring in food samples. Test for Vitamin C using indophenol. List those that have Vitamin C and those that do not have Vitamin C.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
54. Prove the importance of calcium and phosphorus for proper bone development.	Digestion, nutrition, and disease	Observing, inferring, interpreting data	In two jars, place two uncooked chicken bones (or two eggs) one in a jar with water and the other in vinegar. Let stand for several days. Remove and check bones or eggs for stiffness. (Bone or egg in vinegar becomes flexible because vinegar removes calcium.) Optional: Identify sodium chloride in the body. Use silver nitrate and distilled water, cotton, test tubes. Wipe hand with cotton. Place in test tube. After adding silver nitrate, a white cloud forms, showing salt present in body.
55. Define circulation.	Circulatory system	Observing, communicating, defining operationally	Audiovisual aids on circulatory systems. Discussion emphasizing purposes
56. Describe the functional role of the heart, artery, veins, and capillaries.	Circulatory system	Observing, communicating, defining operationally, inferring, classifying, interpreting data	Audiovisual aids Experiment with pulse rates. Determine pulse rate before and after running in place for one minute. Prepare graph of results. Average and list results.
57. Trace the path of blood through the heart.	Circulatory system	Observing, inferring, communicating	1. Draw and label the parts of the heart. Trace the path of oxygenated and deoxygenated blood. Daphnia can be obtained from a biological supply company to view under the microscope. Students should be able to count number of times heart beats in the Daphnia. 2. Dissect animal hearts (cow or pig).

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
58. State the major functions of blood.	Circulatory system	Observing, classifying, communicating, defining operationally	Audiovisual aids, student-teacher discussion. Emphasize what a body cell needs, how blood will get there, and how waste will be eliminated.
59. Identify the four major blood types.	Blood types	Classifying	Use chart showing which blood types are compatible. Discuss blood typing with reference to Anti A and Anti B Serums.
60. Define respiration as the process through which energy is released from food (Food + Oxygen = Energy + waste products).	Respiratory system	Defining operationally	Class discussion
61. Describe breathing and compare inhaled with exhaled air.	Respiratory system	Observing, communicating, defining operationally	1. Mirror experiment 2. Comparison of ordinary air with exhaled air. Invert a bottle filled with water in a pan of water. Have plastic tubing lead under bottle. Blow air into bottle until water is replaced by air. Compare lung capacity rates of students. Optional: B. Lime-water test for CO_2 Prepare a solution of lime water. Breathe into it through a straw. Water will turn cloudy from carbon dioxide being exhaled. A. Use bell jar or gallon jar. (Cut bottom from jar.) Attach a balloon to bottom with tape to form the diaphgram. Insert a tube into

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			hole in stopper. Attach 2 balloons to upper part of y-tube to form lungs. Balloons will inflate and deflate to show lung action.
62. Draw the organs of the respiratory system and state their functions.	Respiratory system	Observing, inferring, communicating, classifying	Student diagrams of respiratory system. Distinguish each part as to its function.
63. Describe the functional role of the brain, spinal cord, and and nerves.	Nervous system	Observing, inferring, communicating, defining operationally	1) Identify the 3 parts of the brain and their functions. 2) Use models and diagrams. 3) Trace the nervous system's reaction (from stimulus to response) to touching a hot match. 4) Explain nerve impulse (Dandrite and Axon)
64. Specify the relationship between the nervous system (five senses) and the environment.	Nervous system	Observing, communicating, classifying, defining operationally, relationships	Lab work--(Reflex experiments, neuromuscular experiments, blind spot experiments)
65. Identify and locate the major organs and/or glands of the endocrine system (pituitary, adrenal, pancreas, thyroid).	Endocrine system	Observing, inferring, classifying, communicating	Given a simple diagram of the body, draw the major endocrine organs or glands.
66. Relate organs and/or glands with the hormones and their functions (pituitary, adrenal, pancreas, thyroid).	Endocrine system	Observing, inferring, classifying, communicating, defining operationally	Devise a chart showing glands, hormone, and use of hormone.
67. Describe various forms of body excretion (solid, liquid, gas).	Excretion	Observing, defining operationally, classifying	Lab work--Mirror experiment (gas) Exercise--sweat (liquid)

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
68. Identify the excretory organs and their functional roles in relation to gas, liquid, and solid waste materials (lungs, kidneys, skin, large intestine).	Excretory system	Observing, inferring, communicating, classifying, defining operationally	Audiovisual aids, charts, diagrams, models, teacher-student discussion
69. State the functions of the skeletal system.	Skeletal system	Observing, inferring, communicating	Audiovisual aids, charts, diagrams, models. Label bones of the body with scientific names. 1. A Halloween skeleton works well for practice labeling scientific names of bones. 2. Human bones can be obtained from medical schools or dental schools.
70. Specify the major parts of the skeletal system (bone, cartilage, ligament) and their functional roles.	Skeletal system	Observing, inferring, communicating, classifying, defining operationally	Student lab: Dissect uncooked chicken leg. Observe muscles, ligaments, and cartilage on bone.
71. State the major functions of the muscular system (movement, mixing of food, pumping blood).	Muscular system	Observing, inferring, communicating	Audiovisual aids, teacher-student discussion, student demonstration on movement
72. Draw the three kinds of muscle tissue (skeletal, smooth, heart).	Muscular system	Observing, inferring, communicating, classifying, defining operationally	Lab observations of three types of muscles on prepared slides. Student drawings (labeled) of those three types.
73. Differentiate between voluntary and involuntary muscles in relation to the three kinds of muscle tissue (voluntary: skeletal--involuntary: smooth and heart).	Muscular system	Observing, communicating, classifying, defining operationally	Demonstration Involuntary--pulse rate, reflex Voluntary--ear wiggling, limb movement

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
VII. Reproduction*			
74. State the difference between sexual and asexual reproduction.	Reproduction, sexual and asexual	Observing, predicting, time/space relationships	Observe in a lab: Asexual: Fission-Paramecium (splitting) Budding; yeast in warm water. Sexual: Paramecium--observe length of time for conjugation.
75. Differentiate between internal and external fertilization.	Fertilization	Defining operationally	Class discussion
76. Differentiate between: a. Male and female reproductive organs (testes and ovary); b. Male and female gametes (sperm and egg); and c. Zygote, embryo, and fetus.	Reproductive structure	Defining operationally	Class discussion
77. Define vegetative propagation as a method of reproduction.	Reproduction, asexual	Communicating, observing, time/space relationships	Start at least two of the following in class to observe over a period of a week. Make observations of growth each day, noting the date. Bulb--onion, beet, turnip, white potato, carrot Cutting--geranium, Jacob's coat, begonia, coleus Collect, record, and interpret data.
IX. HEREDITY AND GENETICS			
78. Define heredity as the passing of traits from parent to offspring.	Heredity	Observing, predicting, communicating	Discuss traits inherited from parents. List inherited traits.

* The committee on CBE minimum standards agrees that reproduction should be included in the curriculum. However, in light of legislative action taken in 1979, these materials should be developed by the local school system.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
79. Identify Gregor Mendel as the "Father of Heredity."	Heredity	Communicating	Class discussion. Optional: Gregor Mendel' Pea Plants Give each student a group of dried seeds (peas) to grow. Compare results with those of classmates.
80. Distinguish between the dominant and recessive traits of the students in a class and chart results.	Heredity	Observing, inferring, classifying, measuring, using numbers, interpreting data	Students will test for at least six of the following traits: Trait — Number of Students with 1. Taste PTC 2. Tongue roll 3. Naturally straight hair 4. Brown eyes 5. Attached ear lobes 6. Female 7. Less than 120 cm tall 8. Red hair 9. Color blind 10. Good vision without glasses Prepare a table in your notebook to record number of individuals with each trait. Using the gathered information, answer the following questions: 1. Which trait occurs most often?

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			2. Which trait occurs least often? 3. Which (if any) occurs in all students? 4. Which (if any) is absent in all students? 5. Are any two traits found together? Students could also compare with close family members, to see if traits are present in family.
IX. ECOLOGY			
81. Recognize the biological relationships of producers, consumers, and decomposers.	Procedures, consumers, decomposers	Observing, inferring, classifying	Classify lists of given organisms according to consumer, producer, and decomposer.
82. Construct a food chain.	Food chain	Inferring, interpreting data, communicating	Using cut-out pictures, construct a variety of food chains. Possible group work with exchange of ideas.
83. Devise a simple chart showing the relationship between animals and plants in the gas cycle.	Gas cycle	Inferring, experimenting	Experiment to show plants give off oxygen. Place a lighted candle and a green plant growing in a container under a jar in sunlight. When candle goes out, all oxygen has been used up. Apply grease (vaseline) around mouth of jar to seal it. After 2 to 3 days, retest the jar with a flaming splinter. The splinter will burn a short while because the plant has given off and restored some oxygen to the jar. Discussion on need and use of CO_2 by plants. Discussion on need and use of oxygen by animals. Construct a chart.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
84. Define conservation (wise use of our natural resources) and identify the major types: a. Soil b. Forest c. Wildlife d. Water e. Energy	Conservation	Communicating, classifying	1. Punch the same number of holes in two fruit jar lids. Place lids top side down on white paper or in sink. Fill each lid 3/4 full of the same soil. In one lid, plant rhizone grass and lightly water. Leave the other lid alone. Within a few days, once grass has taken growth, sprinkle water through both lids. Measure the differences between the two in respect to the amount of erosion which occurred. (Explain the value of a soil cover in preventing erosion.) 2. Trees are identified by their fruits, flowers, bark, buds, twigs, and leaves. a. Obtain a textbook describing tree species native to your region. (Consult local extension service.) b. Have students collect, identify, and discuss leaves from trees in local area. 3. Have students construct a simple bird feeder and set outside (window or school plant); keep a record of the number and kinds of birds that visit over a period of days. 4. Organize student groups to construct posters; diagram on the "water cycle" display and discuss in class.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			5. Organize student groups to report on renewable and non-renewable energy resources. NOTE TO TEACHER: Any one or more of the above activities can be used to reinforce the concept.
85. Define pollution (any process by which man's activities destory the quality of the environment), and make a list of then negative aspects it produces on the environment: (1) spreads disease, (2) upsets balance of or completely destroys ecosystem, and (3) destroys scenic beauty.	Pollution	Communicating, inferring	Ask students to suggest concrete examples from their own environment in order to illustrate how scenic beauty has been destroyed. Optional: Conduct a field trip to an industrial complex in order to view what company officials are doing to prevent pollution.

REFERENCE MATERIAL

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5. McLaren, J.; Stasik, J.; and Levering, D. Spaceship Earth/Life Science. Boston: Houghton Mifflin, 1981.

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7. Smith, H.; Frazier, R.; and Magnoli M. Exploring Living Things. 2nd Edition. River Forest, Illinois: Laidlaw, 1980.

8. Richardson, J.; Harris, A.; and Sparks, O. Life Science. Morristown, New Jersey: Silver Burdett, 1982.

9. Thurber, W.; Kilburn, R.; and Orvell, R. Exploring Life Science. Boston: Allyn and Bacon, 1975.

10. Webster, V.; Fichter, G.; Cable, C.; and Rice, D. Prentice-Hall Life Science. Englewood Cliffs, New Jersey: Prentice-Hall, 1980.

AUDIOVISUAL SUPPLIERS

The audiovisual materials suggested in the curriculum guide can be obtained from the following suppliers:

Association Instructional Materials
347 Madison Avenue (Department DC)
New York, New York 10017

BFA-Ealing Corporation
2211 Michigan Avenue
Post Office Box 1795
Santa Monica, California 90406

BFA-Educational Media
2211 Michigan Avenue
Post Office Box 1795
Santa Monica, California 90406

Beckman Instruments Inc.
Attention: New Dimensions
2500 Harbor Boulevard
Fullerton, California 92634

Coronet Films
65 East South Water Street
Chicago, Illinois 60601

Education Audio-Visual Inc.
Pleasantville, New York 10570

Encyclopaedia Britannica
Educational Corp.
425 North Michigan Avenue
Chicago, Illinois 60611

Inquiry Audio Visuals
1754 West Farragut Avenue
Chicago, Illinois 60640

International Communication Films
1371 Reynolds Avenue
Santa Ana, California 92705

John Wiley and Sons, Inc.
605 Third Avenue
New York, New York 10016

Kalmia
Department C1
Concord, Massachusetts 01742

Lansford Publishing Co.
Post Office Box 8711
1088 Lincoln Avenue
San Jose, California 95155

McGraw-Hill Films
CRM/McGraw-Hill
110 15th Street
Del Mar, California 92014

Modern Learning Aids
1212 Avenue of the Americas
New York, New York 10036

Harper and Row Media
10 East 53rd Street
New York, New York 10022

Holt, Rinehart, and Winston, Inc.
383 Madison Avenue
New York, New York 10017

Indiana University
Audio-Visual Center
Office for Learning Resources
Bloomington, Indiana 47401

Prentice Hall Media
Servode HC236
150 White Plains Road
Terrytown, New York 10591

Scholarly Audio-Visuals Inc.
5 Beekman Street
New York, New York 10038

Science Software Systems Inc.
11899 West Pico Boulevard
West Los Angeles, California 90064

Shell Oil Film Library
1433 Sadlier Circle W. Drive
Indianapolis, Indiana 46239

Modern Talking Picture Service
2323 New Hyde Park Road
New Hyde Park, New York 11040

Peter M. Robeck and Company
230 Park Avenue
New York, New York, 10017

James J. Ruhl and Association
Post Office Box 4301
Fullerton, California 92631

Thorne Films
1229 University Avenue
Boulder, Colorado 80302

Universal Education and Visual Arts
100 Universal City Plaza
Universal City, California 91608

Westwood Educational Productions
701 Westport Road
Kansas City, Missouri 64111

Sutherland Educational Films
201 North Occidental Boulevard
Los Angeles, California 90026

Since these materials vary from quite simple to complex, teachers are urged to preview materials before presenting them to the class.

EVALUATION TECHNIQUES

Methods for evaluating pupils' achievement and progress are an integral part of the instructional program. Evaluation techniques must reflect (1) the objectives to be reached, and (2) the activities employed to reach those objectives. Since the objectives are stated clearly, the method of evaluation is indicated within the objective. The objectives are stated in behavioral terms, the process skills are identified, and suggested activities are listed. Thus, it is clear what the student is expected to be able to do after successful completion of a learning activity. The successful attainment of an objective can be demonstrated by having the student do specific things which can be observed.

Therefore, evaluation should consist of more than just paper and pencil tests on recall of factual knowledge. A variety of evaluation activities should be used.